

SPE05S60T-A/C

主要参数 MAIN CHARACTERISTICS

600V/5A 3相全桥驱动	
V_{CES}	600V
I_c	5A
V_{ISO}	1500V

用途

- 小功率电机
- 油烟机
- 风扇
- 空气净化器
- 洗碗机水泵

APPLICATIONS

- Small-power motor
- Lampblack machine
- Electric fan
- Air purifier
- Dishwasher pump

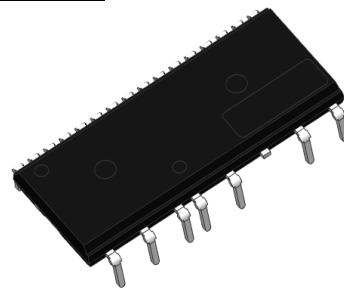
产品特性

- 信号高电平有效, 兼容 3.3V 和 5V 的 MCU
- 内置自举二极管
- 内置欠压保护
- 内部集成温度检测输出
- 绝缘耐压 1500V

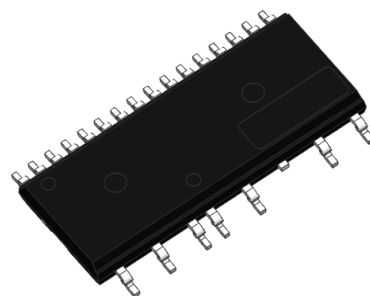
FEATURES

- Signal high level valid, compatible with 3.3v and 5V MCU
- Built-in bootstrap diode
- Built-in undervoltage protection
- Internal integrated temperature detection output
- Resistant to high voltage 1500V

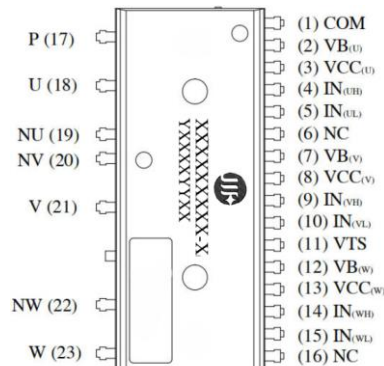
封装 Package



DIP23A-FP



SOP23-FP



订货信息 ORDER MESSAGE

订货料号 Order number	产品信息 Product information			
	无卤-条管 Halogen-Free-Tube	无卤-编带 Halogen-Free-Reel	印记 Marking	封装 Package
2A01-0600	SPE05S60T-C	N/A	SPE05S60T-C	SOP23-FP
2A01-0827	SPE05S60T-A	N/A	SPE05S60T-A	DIP23A-FP

模块分布示意图 Module distribution diagram

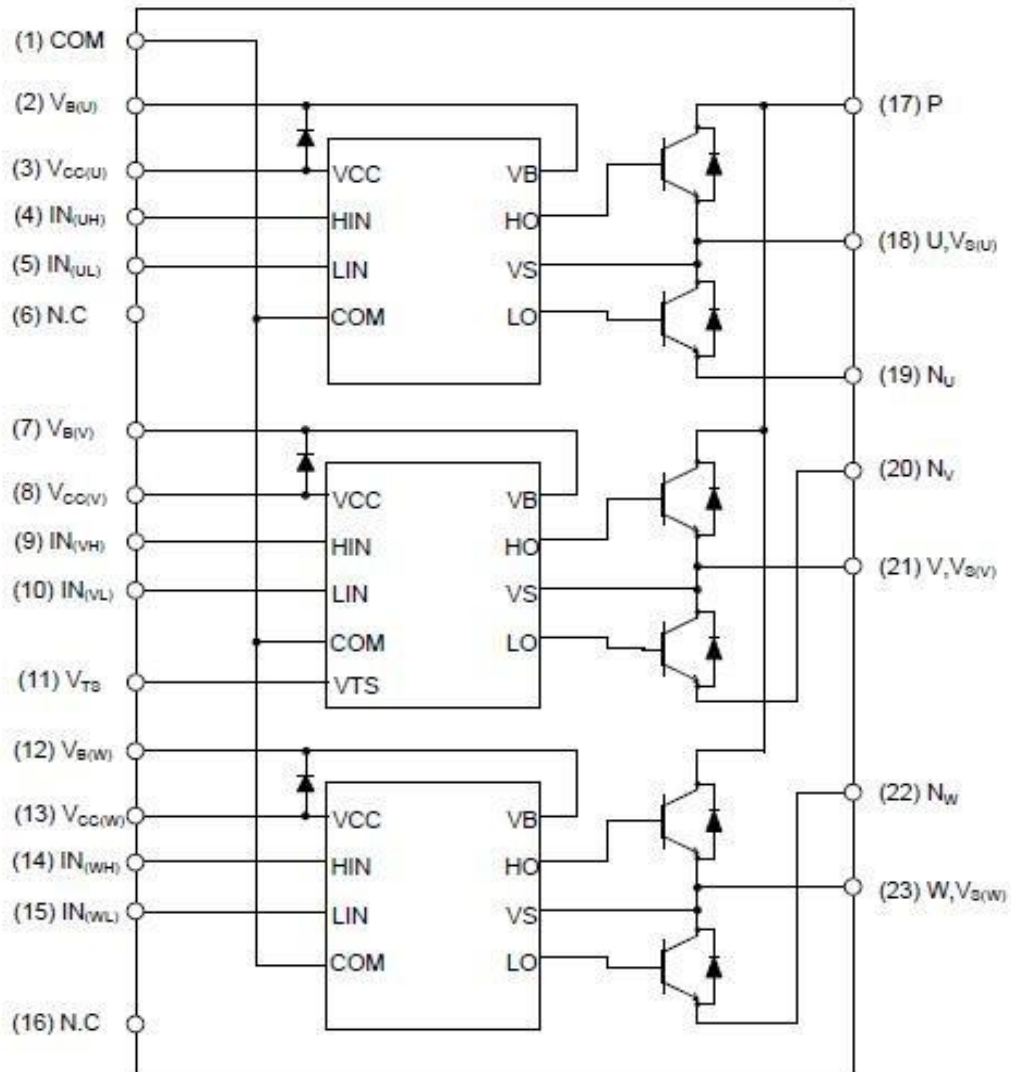


图 1: 模块内部电路示意图

Fig 1: Internal circuit

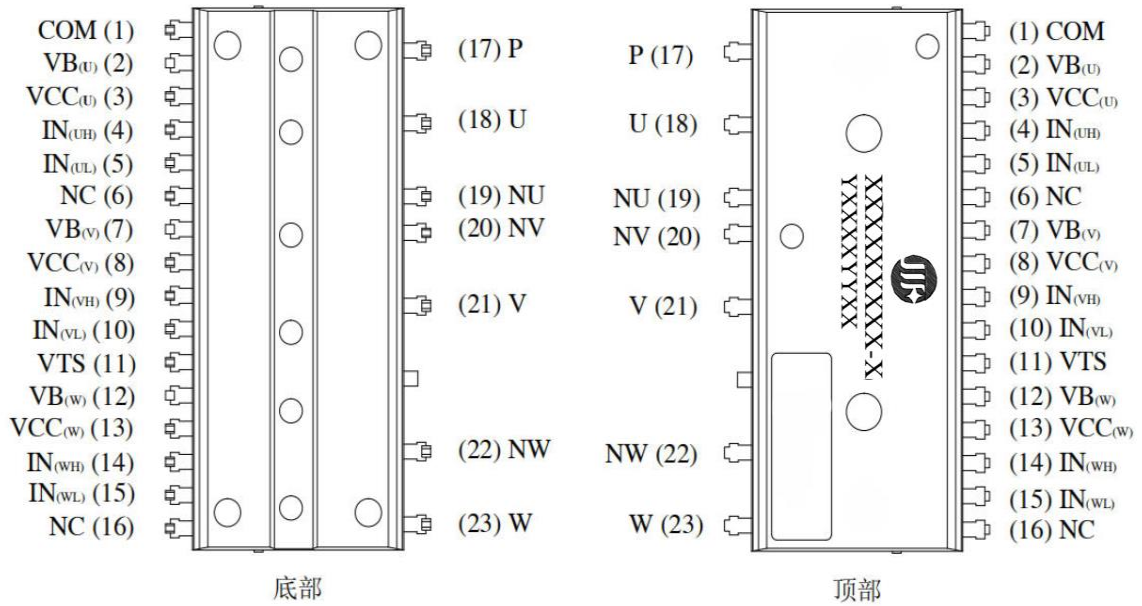


图 2: 模块引脚分布示意图
Fig 2: Distribution of pin

引脚编号 Number	引脚名称 Name	引脚描述 Description
1	COM	IC 公共电源接地 IC Common Supply Ground
2	VB(U)	U 相上臂驱动电源端子 Bias Voltage for U-Phase High-Side IGBT Driving
3	VCC(U)	U 控制电源端子 Bias Voltage for U-Phase IC and Low-Side IGBT Driving
4	IN(UH)	U 相上臂控制信号输入端子 Signal Input for U-Phase High-Side
5	IN(UL)	U 相下臂控制信号输入端子 Signal Input for U-Phase Low-Side
6	NC	无连接 No Connection
7	VB(V)	V 相上臂驱动电源端子 Bias Voltage for V-Phase High Side IGBT Driving
8	VCC(V)	V 控制电源端子 Bias Voltage for V-Phase IC and Low Side IGBT Driving
9	IN(VH)	V 相上臂控制信号输入端子 Signal Input for V-Phase High-Side
10	IN(VL)	V 相下臂控制信号输入端子 Signal Input for V-Phase Low-Side
11	VTS	HVIC 温度输出 Output for HVIC Temperature Sensing
12	VB(W)	W 相上臂驱动电源端子 Bias Voltage for W-Phase High-Side IGBT Driving
13	VCC(W)	W 控制电源端子 Bias Voltage for W-Phase IC and Low-Side IGBT Driving
14	IN(WH)	W 相上臂控制信号输入端子 Signal Input for W-Phase High-Side
15	IN(WL)	W 相下臂控制信号输入端子 Signal Input for W-Phase Low-Side
16	NC	无连接 No Connection
17	P	逆变器直流输入端子 Positive DC-Link Input
18	U, VS(U)	高端 IGBT 驱动的 U 相偏压接地输出 Output for U-Phase & Bias Voltage Ground for High-Side IGBT Driving
19	NU	U 相的直流输入负端 Negative DC-Link Input for U-Phase
20	NV	V 相的直流输入负端 Negative DC-Link Input for V-Phase
21	V, VS(V)	高端 IGBT 驱动的 V 相偏压接地输出 Output for V-Phase & Bias Voltage Ground for High-Side IGBT Driving
22	NW	W 相的直流输入负端 Negative DC-Link Input for W-Phase
23	W, VS(W)	高端 IGBT 驱动的 W 相偏压接地输出 Output for W Phase & Bias Voltage Ground for High-Side IGBT Driving

图 3: 模块引脚功能定义表
Fig 3: Pin function

最大额定值 ($T_j = 25^\circ\text{C}$, 除非特殊说明)Absolute Maximum Ratings ($T_j = 25^\circ\text{C}$, Unless otherwise Specified)

逆变部分 Inverter Part

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
V_{CC}	电源电压 Power supply voltage	应用于 P- NU, NV, NW 之间 Applied between P- NU, NV, NW	450	V
$V_{CC(Surge)}$	电源电压 (含浪涌) Power supply voltage (including surge)	应用于 P- NU, NV, NW 之间 Applied between P- NU, NV, NW	500	V
V_{CES}	集电极-发射极之间电压 Collector emitter Voltage of Each IGBT	/	600	V
$\pm I_C$	集电极电流 Each IGBT Current, Continuous	$T_c = 25^\circ\text{C}$,	5	A
$\pm I_{CP}$	集电极电流 (峰值) Each IGBT Pulse Current, Peak	$T_c = 25^\circ\text{C}$, 脉冲宽度小于 1ms $T_c = 25^\circ\text{C}$, Less than 1ms	10	A
P_c	集电极功耗 Maximum Power Dissipation	$T_c = 25^\circ\text{C}$, 单晶片 $T_c = 25^\circ\text{C}$, Each IGBT	23	W
T_j	结温 Junction Temperature	(见备注 1) Note1	-40~150	$^\circ\text{C}$

控制部分 Control Part

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
V_{CC}	控制电源电压 Control Supply Voltage	V_{CC} -COM 之间 Applied between V_{CC} and COM	20	V
V_{BS}	高侧控制电压 High-side Bias Voltage	VB-VS 之间 Applied between VB and VS	20	V
V_{IN}	输入信号电压 Input Signal Voltage	V_{IN} -COM 之间 Applied between V_{IN} and COM	-0.5~ $V_{CC}+0.5$	V

整个系统 Total System

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
$V_{PN(PROT)}$	自我保护电源电压限制 Self-protecting power supply voltage limit	$V_{CC}=V_{BS}=13.5\text{V}\sim 16.5\text{V}$, $T_j=125^\circ\text{C}$, 非重复性, <2us	400	V
T_c	模块壳体工作温度 Module shell temperature	/	-30~125	$^\circ\text{C}$
T_{STG}	贮存温度 Storage Temperature	$T_c=25^\circ\text{C}$	-40~125	$^\circ\text{C}$
V_{ISO}	绝缘耐压 Isolation Voltage	60Hz, 正弦, AC 1 分钟, 连接管脚到散热器 60Hz, Sinusoidal, AC 1 min, between pins and	1500	V



		heat-sink plate		
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备注 1: IPM 功率晶片最大额定结温为 150° C (@表面温度 $T_C \leq 100^\circ \text{C}$)。然而,为了确保 IPM 运行安全,结温应限定于 $T_{j(av)} \leq 125^\circ \text{C}$ (@表面温度 $T_c \leq 100^\circ \text{C}$)。

NOTE 1: The maximum rated junction temperature of the IPM power chip is 150° C (@surface temperature $T_C \leq 100^\circ \text{C}$). However, to ensure safe operation of the IPM, the junction temperature should be limited to $T_{j(av)} \leq 125^\circ \text{C}$ (@surface temperature $T_C \leq 100^\circ \text{C}$)

热阻 Thermal Resistance

记号 Symbol	参数 Parameter	条件 Condition	额定值 Ratings	单位 Units
Rth(j-c)Q	结到外壳的热阻 Junction to Case Thermal resistance	逆变器工作条件下的单个IGBT Each IGBT	5.5	°C/W
Rth(j-c)F	结到外壳的热阻 Junction to Case Thermal resistance	逆变器工作条件下的单个FRD Each FRD	6.9	°C/W

备注 2: 关于壳体温度 (TC) 的测量点, 参见图 6。

Note 2: For the measurement point of shell temperature (TC), see Figure 6.

电气特性 (Tj=25°C, 除非特殊说明)

Electrical Characteristics (Tj=25°C, Unless Otherwise Specified)

逆变部分 Inverter Part

记号 Symbol	参数 Parameter	条件 Condition		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
V _{CE(SAT)}	集电极-发射极间饱和电压 Collector - emitter saturation voltage	V _D =V _{DB} =15V, V _{IN} =5V	I _C =5A, T _J =25° C,	-	1.8	-	V
			I _C =5A, T _J =125° C,	-	2.1	-	
V _{FC}	FRD正向电压 FRD Forward voltage	V _{IN} = 0V, I _C =-5A,		-	1.6	2.0	V
I _{CES}	集电极-发射极间漏电流 Collector emitter leakage current	V _{CE} =V _{CES}	T _J =25° C	-	-	7.5	uA
			T _J =125° C,	-	-	1	mA
t _{ON}	开关时间 (备注3) Switching Times(Note 3)	V _{PK} = 300 V, V ₀ = V _{DB} = 15 V, I _C =5 A V _{IN} = 0 V ↔ 5 V, 感性负载 / Inductive Load		-	580	-	nS
T _{C(ON)}				-	200	-	
t _{OFF}				-	690	-	
T _{C(OFF)}				-	60	-	
t _{rr}				-	200	-	
E _{on}	开通损耗Turn-on loss	I _C = 5A, V _{CC} = 300V, V _D = V _{DB} = 15V, 感性负载/Tj= 25° C		-	42	-	uJ
E _{off}	关断损耗 Turn-off loss			-	90	-	

备注 3: t_{ON} 和 t_{OFF} 包括驱动 IC 内部传输延迟时间。t_{C(ON)} 和 t_{C(OFF)} 是 IGBT 自身被内部给定门极驱动条件下的开关时间。



控制部分 Control Part

记号 Symbol	参数 Parameter	条件 Condition		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I _{QCC}	VCC 静态电流 Quiescent VCC Supply Current	VCC=15V VIN=5V	VCC-COM 之间 Applied between VCC and COM	-	-	600	uA
I _{QB}	VBS 静态电流 Quiescent VBS Supply Current	VDB=15V VIN=5V	VB(U)-U, VB(V)-V, VB(W)-W 之间 Applied between VB(U)-U, VB(V)-V, VB(W)-W	-	-	210	uA
UV _{CCD}	低侧欠压保护 (图 7) Low-Side Under-Voltage Protection (Fig 7)	检测电平 VCC Under-Voltage Protection Detection Level		7.2	8.2	9.4	V
UV _{CCR}		复位电平 VCC Under-Voltage Protection Reset Level		8.0	8.8	9.8	V
UV _{BSD}	高侧欠压保护 (图 8) High-Side Under-Voltage Protection (Fig 8)	检测电平 VBS Under-Voltage Protection Detection Level		7.2	8.2	9.4	V
UV _{BSR}		复位电平 VBS Under-Voltage Protection Reset Level		8.0	8.8	9.8	V
V _{TS}	HVIC 温度检测输出 HVIC Temperature Sensing Voltage Output	VCC=15V, THVIC=25°C (图 5) (Fig5)		0.6	0.8	1.2	V
V _{IH}	输入开启阈值电压 ON Threshold Voltage	逻辑高电平, 加在 VIN 与 COM 之间 Logic HIGH Level, Applied between VIN and COM		-	-	2.9	V
V _{IL}	输入关闭阈值电压 OFF Threshold Voltage	逻辑低电平, 加在 VIN 与 COM 之间 Logic Low Level, Applied between VIN and COM		0.8	-	-	V
V _{F(BSD)}	自举二极管导通压降 (含 限流电阻分压) bootstrap diode conduction voltage drop (including current limiting resistor voltage)	I _F = 10 mA, T _C = 25°C		-	3	-	V
R _{BSD}	BSD 限流电阻 Built-in limiting resistance			-	280	-	ohm





推荐工作条件 Recommended Operating Conditions

记号 Symbol	参数 Parameter	条件 Condition	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
V _{PN}	电源电压 Supply Voltage	施加在P和N之间 Between P and N	-	300	400	V
V _{CC}	控制电源电压 Control Supply Voltage	施加在V _{CC} 和 COM之间 Between V _{CC} and COM	13.5	15.0	16.5	V
V _{BS}	高端偏压 High-Side Bias Voltage	施加在V _B 和V _S 之间 Between V _B and V _S	13.5	15.0	16.5	V
d _{VCC/dt} , d _{VBS/dt}	控制电源波动 Control power fluctuation		-1	-	1	V/us
V _{IN(ON)}	输入导通阈值电压 Input ON Threshold Voltage	施加在V _{IN} 和COM之间 Between V _{IN} and COM	2.8	-	V _{CC}	V
V _{IN(OFF)}	输入关断阈值电压 Input OFF Threshold Voltage		0	-	0.6	V
t _{dead}	防止桥臂直通的死区时间 Blanking Time for Preventing Arm-Short	V _{CC} = V _{BS} = 13.5 ~ 16.5 V, T _j ≤ 150°C	1.0	-	-	us
F _{PWM}	PWM 开关频率 PWM Switching Frequency	T _j ≤ 150°C	-	-	20	KHz
COM	COM 电压波动 COM voltage fluctuation	COM 和 NU, NV, NW 之间 (包括浪涌) Between COM and NU, NV, NW	-5	-	+5	V

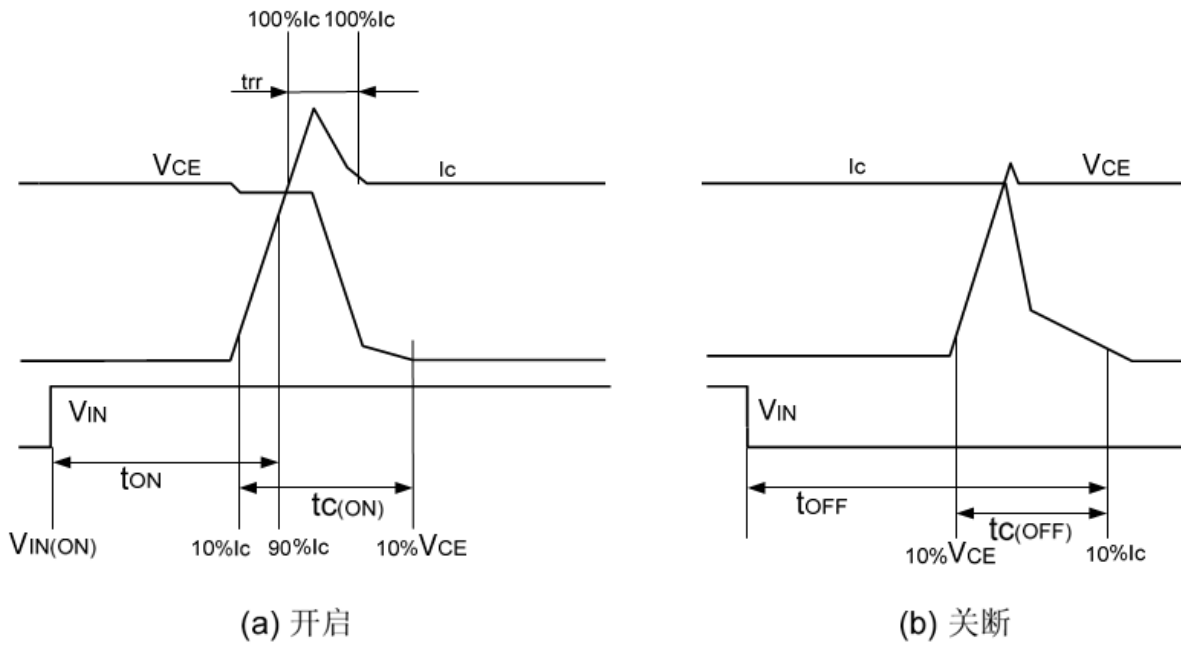


图 4: 开关时间定义

Fig 4: Switching Time Definition

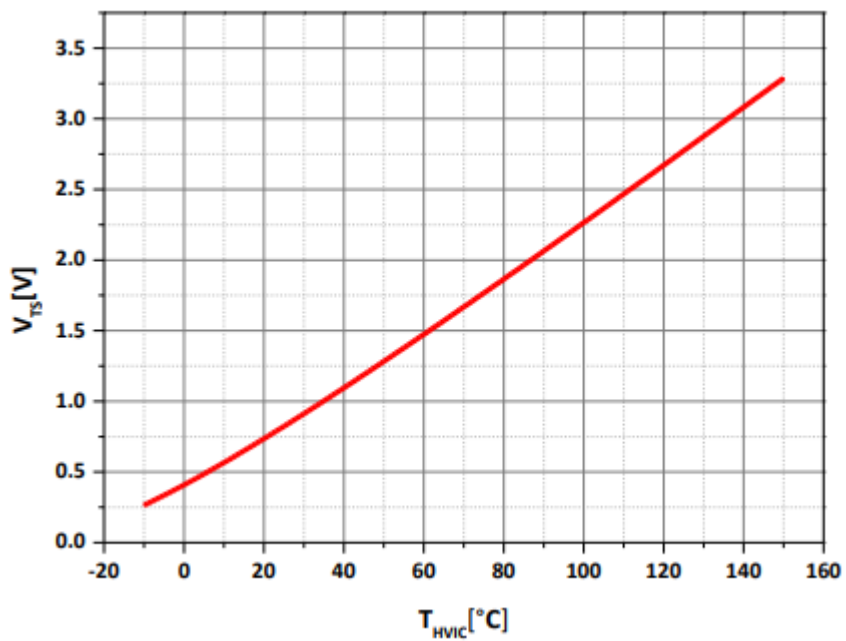


图 5: HVIC 温度检测输出温度—电压曲线

Fig 5: Curves of HVIC Temperature detection-voltage curve

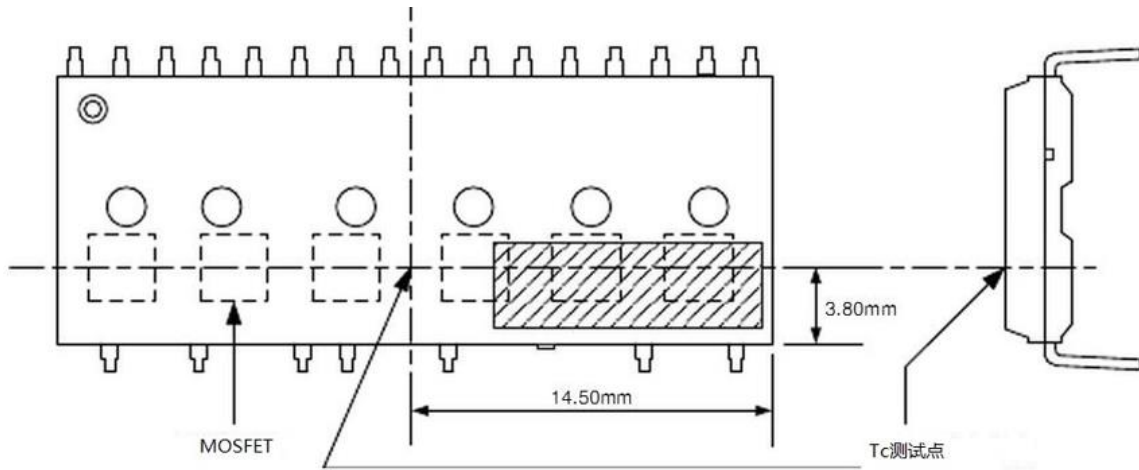


图 6: 壳温 Tc 测试点
Fig 6: Case Temperature Measurement

保护功能时序图 Time Charts of Protective Function

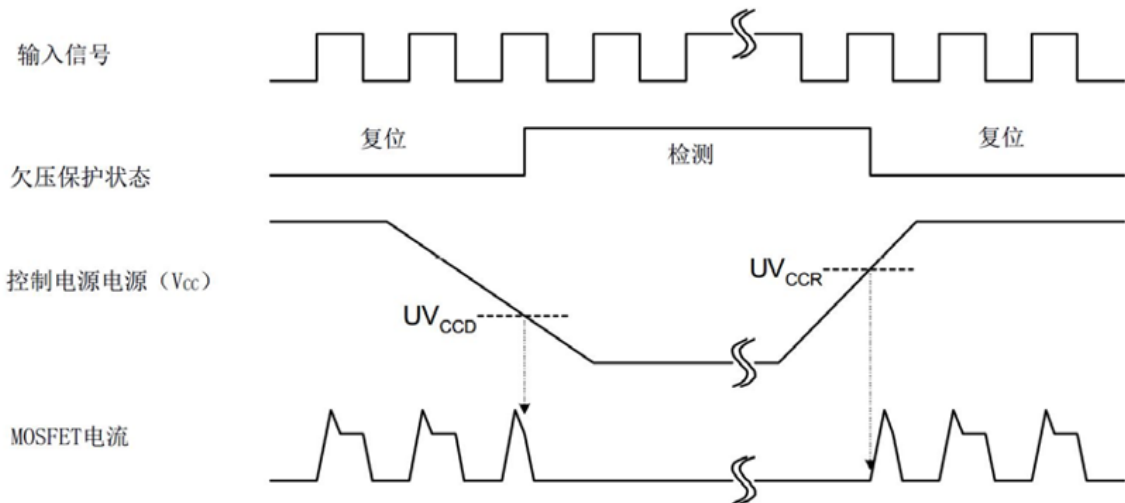


图 7: 欠压保护时序图(低侧)
Fig 7: Undervoltage protection sequence diagram (low side)

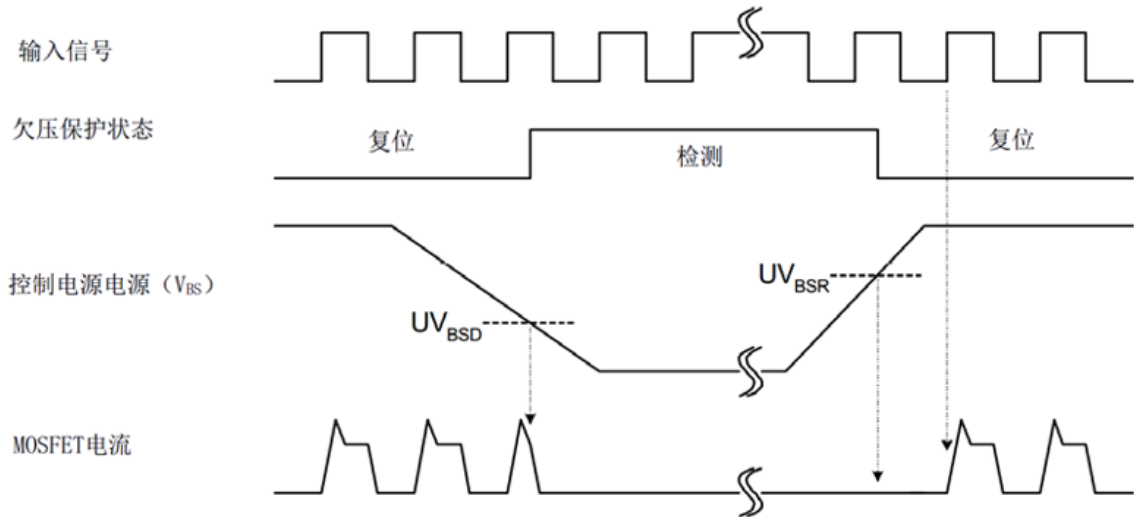


图 8: 欠压保护时序图(高侧)

Fig 8: Undervoltage protection sequence diagram (High side)

应用电路 Application Circuit

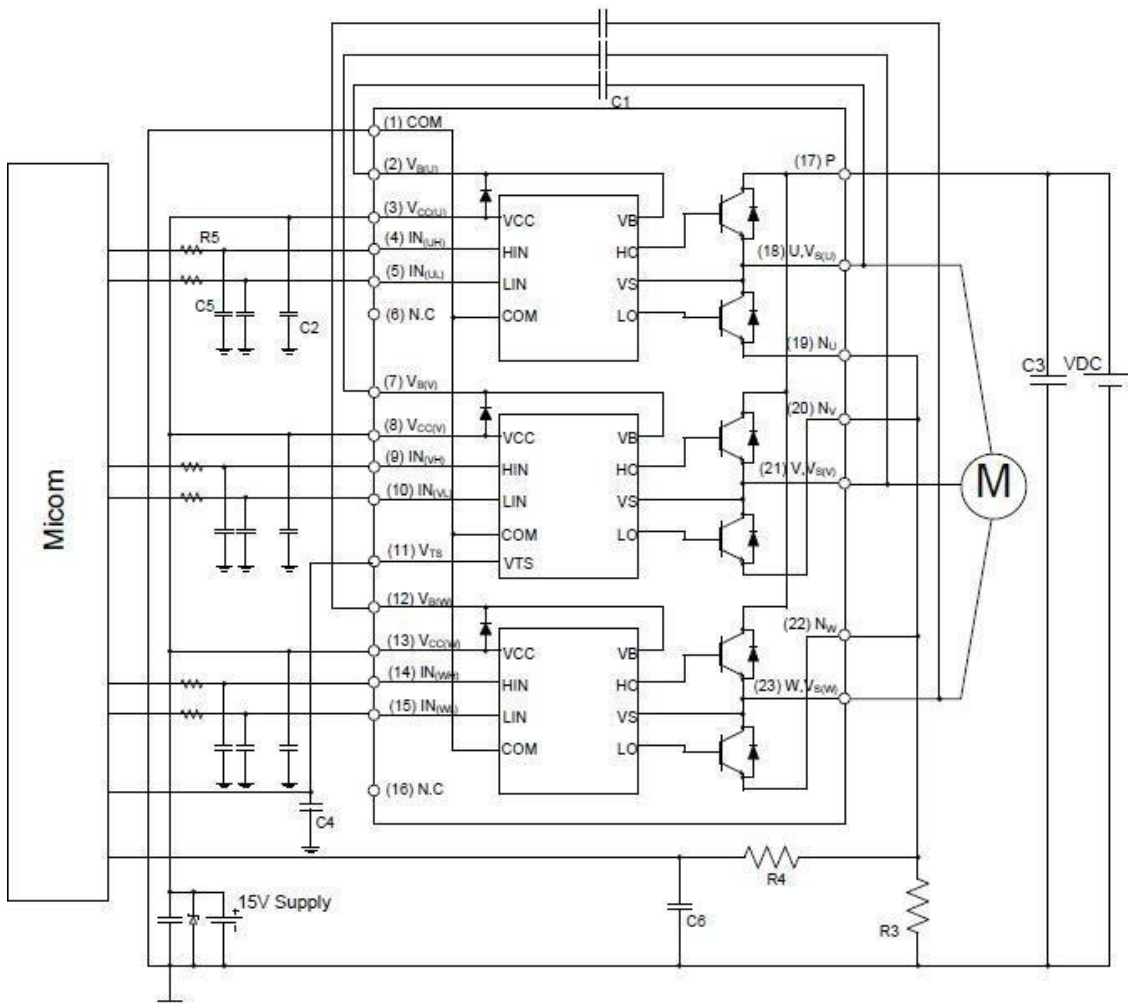


图 9：典型应用电路图

Fig 9: Example of Application Circuit

注/Note:

备注 4: 关于引脚的位置请参阅图 1.

NOTE 4: Refer to figure 1 for pin location.

备注 5: IPM 产品和 MCU 的每个输入端的 RC 耦合 (R5 和 C5, R4 和 C6) 和 C4, 能有效地防止由浪涌噪声产生的错误的输入信号。

NOTE 5: The RC coupling (R5 and C5, R4 and C6) and C4 of each input terminal of IPM product and MCU can effectively prevent the wrong input signal generated by surge noise.

备注 6: 由于位于 COM 和低端 IGBT 的源极端子之间, R3 的压降会影响低端的开关性能和自举特性。为此稳态情况下的 R3 的压降应小于 1V。

NOTE 6: Because it is located between COM and the source terminal of low-end IGBT, the voltage drop of R3 will affect the switching performance and bootstrap characteristics of low-end. For this reason, the pressure drop of R3 under steady-state conditions should be less than 1V.

备注 7: 为避免浪涌电压和 HVIC 故障, 接地线和输出端子之间的接线应短且粗。



NOTE 7: in order to avoid surge voltage and HVIC failure, the wiring between the grounding wire and the output terminal should be short and thick.

备注 8: 所有的滤波电容器应紧密连接到 IPM 产品, 他们应当具有能够很好的阻挡高频纹波电流的特性。

NOTE 8: All filter capacitors shall be closely connected to IPM products, and they shall have the characteristics of good blocking high-frequency ripple current.



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